monitor circuits located at said output ports for monitoring the optical signals outputted to the output circuits and for generating a feedback signal, wherein said selected input signal adjusting unit adjusts the optical signals based on the feedback signal.

13. The optical switch as claimed in claim 12, wherein said monitor circuits monitor an amplitude of the optical signals outputted from said optical switching unit to generate the feedback signals.

14. The optical switch as claimed in claim 12, wherein said monitor circuits monitor differential loss among different channels outputted from said optical switching unit to generate the feedback signals.

REMARKS

The Applicants respectfully request the Examiner to reconsider the pending rejections. For the rejections, the Applicants provided the following arguments for distinguishing the cited prior art reference without any amendment to the pending claims. The Applicants have added new claims without introducing new matter. Furthermore, the Applicants have voluntarily amended the specification to correct some informalities.

Section 102 Rejections

The Examiner rejected claims 1 through 7 under 35 U.S.C. §102(b) as being anticipated by Nguyen. The Examiner stated without specific reference to the claim language that Figures 1 and 2 of the Nguyen reference teaches every step of independent claims 1, 2 and 5. The Examiner's characterization of the pending claims appears to be improper for the following specific claim language.

Independent claim 1 explicitly recites "monitoring the optical signals at the output port connected to the selected monitor circuit to generate a feedback signal. . . ." Similarly, independent claim 2 explicitly recites "monitoring the optical signals at the output port connected to the selected output signal monitoring unit to generate a feedback signal. . . ." Lastly, independent claim 5 explicitly recites "monitoring the optical signals

at an output port connected to the selected output signal monitoring unit to generate a feedback signal. . . ." As explicitly recited above, the optical signals are monitored "at the output port," and the output port is a part of "the switching unit." For example, the monitor circuit 107-1 through 107-N are located at the output ports105-O1 through 105-ON as explicitly recited in the above independent claims.

In sharp contrast to the above explicit recitations in the independent claims, the Nguyen reference discloses with respect to FIGURES 1 and 2 that the monitoring unit or the detectors 45 and 47 are located within the amplifier 20. In other words, the monitors 45 and 47 are located in front of a plurality of optical paths 22, and the monitors 45 and 47 measure the optical signals that have not gone through a selected one of the optical paths 22. In view of the above distinction, the Applicants respectfully submit to the Examiner to reconsider the current rejections.

Furthermore, independent claim 1 explicitly recites "amplifying the optical signals by the selected optical amplifier based upon the feedback signal." Similarly, independent claims 2 and 5 explicitly each recite "amplifying the optical signals by the selected input signal adjusting unit based upon the feedback signal." As explicitly recited above, the optical signals are amplified by "the selected optical amplifier" or "the selected input signal adjusting unit" based upon "the feedback signal." For example, one amplifier or input signal adjusting unit is selected from the amplifiers 104-1 through 104-N as explicitly recited in the above independent claims.

Again, in sharp contrast to the above explicit recitations in the independent claims, the Nguyen reference discloses with respect to FIGURES 1 and 2 that the amplifier adjusts an optical signal to a desired level by selecting a laser source. In other words, the Nguyen reference fails to disclose the adjustment by selecting a single amplifier from a predetermined set of the amplifiers.

In view of the above distinctions, the Applicants respectfully submit to the Examiner to withdraw the currently pending section 102 rejections.

Newly Added Claims

The Applicants have added claims 8 through 14 to the current application in the current response. These claims are added without introducing new matter, and they have been supported by the original disclosures of the current application. The Applicants respectfully submit that the newly added claims should be entered.

Conclusion

In view of the above amendments and the foregoing remarks, Applicant respectfully submits that all of the pending claims are in condition for allowance and respectfully request a favorable Office Action so indicating.

Respectfully submitted,

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Ken I. Yoshida, Esq.
Reg. No. 37,009

KNOBLE & YOSHIDA LLC
Eight Penn Center, Suite 1350
1628 John F. Kennedy Blvd.
Philadelphia, PA 19103
(215) 599-0600

Specifically, the optical signals received from the particular one of the optical fibers 210-1~ 210-K through a particular one of the optical input circuits 101-1~ 102-K that is the realized by means of optical amplifiers, etc. are wavelength-demultiplexed by a particular one of wavelength demultiplexers 102-1~ 102-K for each wavelength. The optical signal of each wavelength has its wavelength converted or regenerated by a particular one of the transponders or regenerators 103-1~103-K (TDR or RGN), which is then fed to a particular one of the optical amplifiers 104-1~104-N of the optical switching apparatus of the present invention.

After passing through a particular input ports105-I1 ~ 105-IN of N X N optical switches 105, the optical signal, with its amplitude being controlled by a particular optical amplifiers 104-1~104-N depending on the particular input circuit, is switched and transferred to one of the output ports 105-O1 ~ 105-ON of the optical switches 105 depending on the destination of the optical signal. The optical signal switched by the optical switches 105 passes through optical splitters or optical couplers 106-1 ~ 106-N. The optical signal of each wavelength is then converted or regenerated by transponders or regenerators 103-1 ~ 103-K (TDR or RGN) in the same manner as the optical signal being converted or regenerated before reaching the particular input ports 105 I1~105IN of the optical switch 105. Optical signals with different wavelengths are then appropriately wavelength-division-multiplexed by the wavelength multiplexers 108-1 ~ 108-K, and are then outputted to the optical fibers 220-1 ~ 220-K through the output circuits 109-1 ~ 109-K that are realized by optical amplifiers, etc. in the same manner as the input circuits.

Monitor circuits 107-1 ~ 107-N monitor the state of the optical signals such as the optical signal amplitude and the differential loss between the channels at each output port of the optical switch 105. A controller 110 includes a monitor selector 121, for selecting one of the monitor circuits 107-1 ~ 107-N, an amplifier controller 122 that controls each of the optical amplifiers 104-1 ~ 104-N, which compensate optical signals before their reaching the input ports 105I1 ~ 105IN according to the state of the outputted optical signal, an optical switch driver or operational unit 123, a switch control unit 124, which sets up the optical transfer paths from the input ports 105-I1 ~ 105IN to the output port 105-O1 ~ 105-ON of the optical switch 105 and a supervisory control unit 125, which

CPU 131 searches and selects a particular one of the optical amplifiers 104-1 ~ 104-N that is connected to a particular input port based on the selected monitor circuit and the connection set-up information in the switch information memory 132 in Step S41.

Through the transfer control unit 144, the digital data, that is the feedback signal from the selected monitor circuit is transferred from the write register 142 to the readout register 143~~,~~ and finally to the comparator 146 in Step S42.

The comparator compares the digital data received in Step S42 and the control target value obtained from the optical amplifier memory 133 and generates a result in Step S43. The parameter-processing unit 147 prepares the parameters based on the comparison result in Step S43 to control the particularly selected one of the optical amplifiers 104-1 ~ 104-N, and it controls the selected one of the optical amplifiers 104-1 ~ 104-N through the digital-to-analog converter 148 in Step S44 to compensate for the loss and the differential loss among the different channels of the optical signals at the optical switch output port.

The above compensation steps S40 ~ S44 are repeated until all the optical paths in the optical switch 105 have been set up Step S45. Through its optical amplifiers 104-1 ~ 104-N, the optical switching apparatus 100' of the present invention properly compensates the loss and differential loss in optical signals after they pass through different channels in the optical switch 105 by monitoring the output ports of the optical switch 105. In addition, a high-speed and high-capacity optical switching apparatus with a simple configuration and the procedure and method of using this apparatus are describe as follows: Since the CPU 131 selects ~~the~~ one of the monitor circuits 107-1 ~ 107-N based on the content of the firmware or the software, the loss and the differential loss among the channels of the optical signals is easily and securely compensated even while the apparatus 100' is in service. Furthermore, when the optical connection configuration of the apparatus is changed, such a change is easily incorporated by modifying the firmware or the software in the optical switching apparatus 100'.

Figure 6 is an explanatory diagram that illustrates an example of the improvement of optical signals made by the optical switching apparatus of the present invention. When the optical switching apparatus 100 or 100' of the present invention is implemented in a communication network, the actual loss or differential loss among the

4. The method as claimed in claim 2, wherein the output signal monitoring units monitor a differential loss among different channels outputted from the optical switching unit to generate the feedback signals.

5. A method of switching optical signals from a plurality of input circuits to one of a plurality of output circuits, comprising the steps of:

selecting a particular one of the output signal monitoring units;

monitoring the optical signals at an output port connected to the selected output signal monitoring unit to generate a feedback signal;

selecting a particular one of the input signal adjusting units based on a predetermined configuration of an optical switching unit; and

amplifying the optical signals by the selected input signal adjusting unit based on the feedback signal.

6. The method as claimed in claim 5, wherein the output signal monitoring units monitor an amplitude of the optical signals outputted from the optical switching unit to generate the feedback signals.

7. The method as claimed in claim 5, wherein the output signal monitoring units monitor differential loss among different channels outputted from the optical switching unit to generate the feedback signals.

<u>8. An optical switch for switching optical signals from a plurality of input circuits to one of a plurality of output circuits, comprising:</u>

<u>an optical switching unit;</u>

<u>input ports connected to said optical switching unit for inputting the optical signals to said optical switching unit;</u>

<u>output ports connected to said optical switching unit for outputting the optical signals from said optical switching unit;</u>

optical amplifiers connected to said input ports for amplifying the optical signals received by the input circuits;

monitor circuits located at said output ports for monitoring the optical signals outputted to the output circuits;

a monitor selector connected to said monitor circuits for selecting one of said monitor circuits, the selected monitor circuit being operationally connected to one of said output ports for generating a feedback signal; and

an amplification control connected to said monitor selector and said optical amplifiers for selecting one of said optical amplifiers based on a predetermined configuration of the optical switch, wherein said selected optical amplifier amplifies the optical signals based on the feedback signal.

9. An optical switch for switching optical signals from a plurality of input circuits to one of a plurality of output circuits, comprising;

an optical switching unit;

input ports connected to said optical switching unit for inputting the optical signals to said optical switching unit;

output ports connected to said optical switching unit for outputting the optical signals from said optical switching unit;

input signal adjusting units connected to said input ports for adjusting state of the optical signals received by the input circuits;

monitor circuits located at said output ports for monitoring the optical signals outputted to the output circuits;

a monitor selector connected to said monitor circuits for selecting one of said monitor circuits, the selected monitor circuit being operationally connected to one of said output ports for generating a feedback signal; and

a control connected to said monitor selector and said input signal adjusting units for selecting one of said input signal adjusting units based on a predetermined configuration of the optical switch, wherein said selected input signal adjusting unit adjusts the optical signals based on the feedback signal.

10. The optical switch as claimed in claim 9, wherein said output signal monitoring units monitor an amplitude of the optical signals outputted from the optical switching unit to generate the feedback signals.

11. The optical switch as claimed in claim 9, wherein said output signal monitoring units monitor a differential loss among different channels outputted from the optical switching unit to generate the feedback signals.

12. An optical switch for switching optical signals from a plurality of input circuits to one of a plurality of output circuits, comprising;

an optical switching unit having an output port and an input port;

input signal adjusting units connected to said input ports for adjusting state of the optical signals received by the input circuits; and

monitor circuits located at said output ports for monitoring the optical signals outputted to the output circuits and for generating a feedback signal, wherein said selected input signal adjusting unit adjusts the optical signals based on the feedback signal.

13. The optical switch as claimed in claim 12, wherein said monitor circuits monitor an amplitude of the optical signals outputted from said optical switching unit to generate the feedback signals.

14. The optical switch as claimed in claim 12, wherein said monitor circuits monitor differential loss among different channels outputted from said optical switching unit to generate the feedback signals.

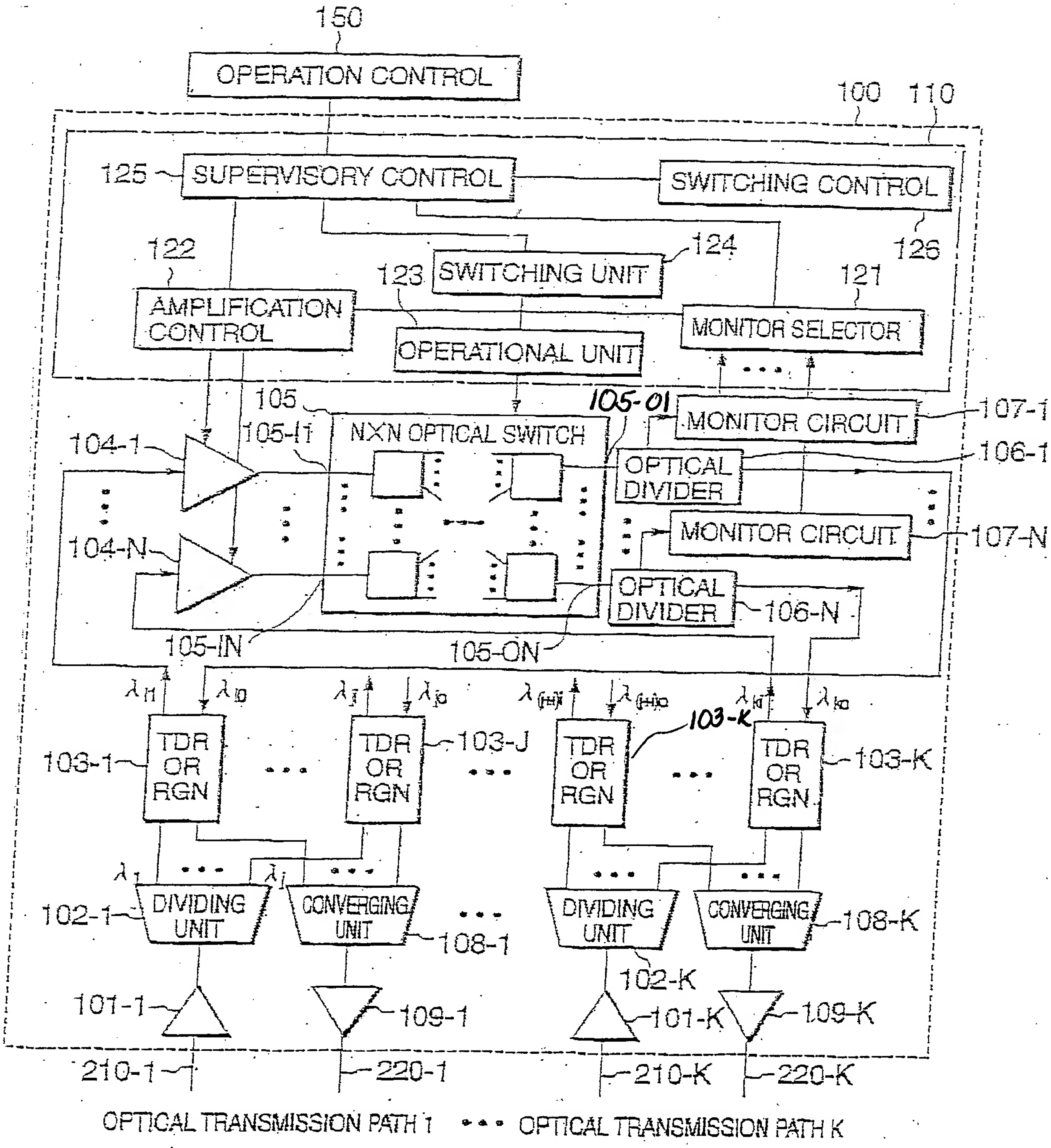
150
OPERATION CONTROL
100
110
125
SUPERVISORY CONTROL
SWITCHING CONTROL
126
124
SWITCHING UNIT
122
123
121
AMPLIFICATION CONTROL
OPERATIONAL UNIT
MONITOR SELECTOR
105
105-01
MONITOR CIRCUIT
107-1
104-1
105-I1
NXN OPTICAL SWITCH
OPTICAL DIVIDER
106-1
104-N
MONITOR CIRCUIT
107-N
OPTICAL DIVIDER
106-N
105-IN
105-ON
103-K
TDR OR RGN
103-1
103-J
103-K
DIVIDING UNIT
CONVERGING UNIT
102-1
108-1
108-K
102-K
101-1
109-1
101-K
109-K
210-1
220-1
210-K
220-K
OPTICAL TRANSMISSION PATH 1
OPTICAL TRANSMISSION PATH K

FIG.2